

INDOOR AIR QUALITY ASSESSMENT

**Brockton North Junior High School
Brockton, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

On December 21, 1998 Cory Holmes, Environmental Analyst, Emergency Response/Indoor Air Quality Program, BEHA conducted an indoor air quality assessment at the North Junior High School in Brockton, Massachusetts. Mr. Holmes was accompanied by Mr. Joe Thomas of the Brockton Board of Health. This assessment was prompted by a report of a case of occupational asthma to the Department of Public Health, Bureau of Health Statistics Research & Evaluation, Occupational Health Surveillance Program.

The school is a two-story brick building built in 1957. The second floor consists of general classrooms; teacher's planning room, library, art room, computer room, a conference room and the history office, which is a converted storage room. The first floor contains general classrooms, the main office area, guidance office, kitchen, cafeteria, auditorium, gymnasium, locker rooms, wood shop, teachers' lounge and a disciplinary/suspension room. Also located on the first floor is a discontinued metal shop facility, which is currently being used as a classroom.

Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, TH Pen PTH 8708 Thermo-Hygrometer.

Results

This school has a student population of 640 and a staff of approximately 55. The tests were taken under normal operating conditions. Test results appear in Tables 1-7.

Discussion

It can be seen from the tables that carbon dioxide levels were elevated above 800 ppm in 32 of the 39 areas surveyed. Of particular note were classrooms 101 and 109, which had levels of carbon dioxide in excess of 2000 ppm. Also of note were classrooms 104, 108, 203, the teachers' planning room, computer room 221 and conference room 250, which had levels of carbon dioxide above 800 ppm without occupancy during the air monitoring, which indicates little or no air exchange.

Carbon dioxide levels were above the comfort guidelines set by the BEHA in the majority of the classrooms surveyed, which is indicative of an overall ventilation problem in this school. Fresh air in classrooms is supplied by a unit ventilator (univent) system. These univents were not functioning in a number of the examined classrooms. Obstructions to airflow, such as student desks, chairs and objects stored on univents were also observed in a number of classrooms. In order for univents to function as designed, air intakes must be unblocked and remain free of obstructions. The teachers' planning room, conference room 250, library annex room, classroom 219 and the guidance office do not contain mechanical supply ventilation.

Exhaust ventilation is provided by grilled, ducted wall vents. Exhaust vents were not functioning in number of classrooms. Exhaust vents were also obstructed by bookcases, desks, chairs, trash cans and in the cafeteria, an open door. One of the exhaust vents in the cafeteria is located on the wall behind the hallway door. When this door is shut, the vent is clear. In an effort to improve airflow, some teachers will leave the hallway door open.

However, when the door is open, the exhaust vent is blocked, therefore interfering with the proper function of the system.

In order to have proper ventilation with a univent and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air. Information regarding the date of the last servicing and balancing of these systems was not available at the time of the visit.

Mechanical ventilation in the auditorium is provided by ceiling mounted air diffusers. BEHA staff were unable to determine if this system was operating, since these vents were approximately 20 feet above the auditorium floor. Musty odors were noted in this area. Continuous operation of the auditorium ventilation system to remove odors and exchange air is important.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Microbial/Moisture Concerns

Caulking around the interior and exterior of windowpanes is crumbling, missing or damaged throughout the school. Rooms 106, 107, 201, 202, and 209 contained broken windows. Broken windows in classrooms 201 and 202 were stuffed with rags to prevent water penetration. Three broken windows were noted in the cafeteria, one of which had been sealed with duct tape. Many of these rooms had water-damaged windowsills, curtains and wall plaster, which is evidence of water intrusion through improperly sealed windows. Repeated water damage can result in mold colonization of the wooden window frames and porous materials (e.g. curtains). Once mold has colonized, these materials are difficult to clean and should be replaced. According to school personnel, replacement of the window system at this school is scheduled for the summer of 1999. The window replacement project should include an examination of wooden windowsills and wall-plaster surrounding window frames for water-damage and structural integrity.

The cafeteria and gymnasium contain exterior doors. Several of the doors were not sealed properly and showed signs of repeated water damage. Buckling floor tiles and floor boards indicate water penetration through these doors. In some instances outdoor light penetration could be seen through the door frame. Spaces beneath exterior doors can serve

as a source of water entry, which can cause water damage and potentially lead to mold growth.

A large number of rooms had water-stained ceiling tiles, which are evidence of historic roof or plumbing leaks. Some water-stained ceiling tiles appeared to have been painted over in classroom 101. Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired.

Several classrooms also had a number of plants. Plant soil and drip pans can serve as source of mold growth. Plants should also be located away from univents. Classroom 113 and 201 contained a number of plants located on the windowsills in trays of standing water. Standing water can become stagnant and provide a medium for bacterial and mold growth.

Classrooms 108 and 110 contained plants in window planters. Window planters are designed to be mounted on the outside of windows and therefore do not have drip pans. The lack of drip pans can lead to water pooling and mold growth on windowsills when used indoors. Wooden sills, can be potentially colonized by mold growth and serve as a source of mold odor. Classroom 103 had three plants, which rested on a cloth material. If this cloth becomes wet repeatedly, it can become colonized by mold.

Classroom 209 had spaces around tile near the sink countertop. Improper drainage or overflow could lead to water penetration of countertop wood and potential damage to the cabinet interior. Water-damaged wood and standing water may also be a potential source of mold growth.

Other Concerns

Cleaning products and insecticides were found in a number of classrooms. These items contain chemicals, which can be irritating to the eyes, nose and throat and should be

stored properly and out of reach of children. Classroom 209 contained insecticides as well as spray paints, rubber cement, isopropyl alcohol and an unlabeled spray product. Some of these items contain volatile organic compounds (VOCs) which can be irritating to the eyes, nose and throat. In addition, rubber cement is a flammable material, which should be stored in a flameproof cabinet.

Missing ceiling tiles and unsealed utility holes in ceilings and walls were observed in several areas throughout the school. Holes in ceilings and walls can provide pathways for the movement of odors, fumes, dusts and vapors between rooms and floors.

Computer room 221 contains 2 mimeographs and a transparency machine. Transparency machines can give off odors. Mimeograph duplicating fluid contains methanol (methyl alcohol), which is a volatile organic compound that readily evaporates at room temperature. Without a functioning ventilation system, these odors can build up. The off gassing of this material can be irritating to the eyes, nose and throat. Methanol is also a highly flammable material, which can be ignited by either flame or electrical source.

Missing ceiling tiles in the gym instructor's office revealed a spray on insulation material, which may or may not be asbestos. Water-damage in this area is evident because of stained/missing ceiling tiles and water stains and mold growth on an adjacent wall. Such water intrusion can damage insulating materials and when dried, present opportunities for exposure. The Division of Occupational Safety (DOS) of the Massachusetts Department of Labor and Workforce Development (MDLWD) should be consulted for an assessment of asbestos in this school.

Fiberglass insulation material was noted around pipes in the cafeteria. Fiberglass material can produce eye, skin and respiratory irritation to certain individuals if it becomes airborne. A number of classrooms had excessive amounts of chalk dust. Chalk dust can also be a source of eye and respiratory irritation.

Conclusions/Recommendations

In view of the findings at the time of our inspection, the following recommendations are made:

1. Examine each univent for function. Operate univents while classrooms are occupied. Check fresh air intakes for repair and increase the percentage of fresh air intake if necessary.
2. Examine exhaust ventilation for function. Repair motors if necessary and operate exhaust system during occupancy.
3. Operate auditorium ventilation system during hours of school operation to remove musty odors and to circulate air.
4. Remove all obstructions from univents and exhaust vents to facilitate airflow.
5. Consider providing mechanical ventilation to the teachers' planning room, conference room 250, library annex room, classroom 219 and the guidance office.
6. Once both the fresh air supply and the exhaust ventilation are functioning, the system should be balanced.
7. Replace any water-stained ceiling tiles. Examine area above these tiles for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
8. Continue with plans to have windows replaced. Examine areas around window frames (e.g. wall plaster, wooden windowsills, etc.) for water damage and repair/replace if necessary.
9. Until windows are replaced, repair broken windows and seal window frames to prevent water penetration. Examine water-damaged areas for mold growth and disinfect with an appropriate antimicrobial.

10. Examine plants in classrooms for mold growth in water catch basins. Disinfect water catch basins if necessary. Ensure drip pans are placed underneath plants in classrooms. Consider discontinuing the use of window planters inside the building.
11. Install weather-stripping around exterior doors to prevent water intrusion.
12. Seal areas around sink in classroom 209, to prevent water-damage to interior of cabinets.
13. Discard water-damaged curtains in classroom 221.
14. Store chemicals and cleaning products properly.
15. Have a chemical inventory done in all storage areas and classrooms. Properly store flammable materials in a manner consistent with the local fire code. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous materials. Obtain Material Safety Data Sheets (MSDS) for chemicals from manufacturers or suppliers. Maintain these MSDS' and train individuals in the proper use, storage and protective measures for each material in a manner consistent with the Massachusetts Right-To-Know Law, M.G.L. c. 111F.
16. Seal utility holes in ceilings and walls to prevent egress of odors, fumes and vapors.
17. Utilize mechanical exhaust ventilation in classroom 221, to remove transparency and mimeograph odors.
18. Repair damaged fiberglass insulation around pipes in the cafeteria.
19. Clean chalk treys and boards regularly to avoid the build up of excessive chalk dust.
20. Consultation with the Department of Labor and Workforce Development, Division of Occupational Safety, Lead and Asbestos Program (617) 969-7177 and/or a

licensed asbestos abatement contractor would be advisable to assess the spray-on insulation material in the gym instructors office.

21. During installation of windows, the following steps should be taken to minimize the impact of renovations on indoor air quality in this building: a) block hallway and other doors to classrooms to prevent odor/dust migration, b) provide local mechanical exhaust ventilation to exhaust the renovated classroom directly outdoors, c) follow product instructions for application and d) allow ample time for curing of caulking materials.

References

MGL. 1983. Hazardous Substances Disclosure by Employers. Massachusetts General Laws. M.G.L. c. 111F.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R. 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

TABLES

Indoor Air Test Results – Brockton, North Junior High School – Dec 21, 1998

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	437	44	54					
Teachers Planning Room	980	75	33	0	Yes	No	No	Water-damaged plaster—wallpaper peeling, caulking missing, damaged windows, CT (1) missing
Conference Room # 250	944	74	33	0	Yes	No	No	Missing caulking around windows Wooden – window frame
Room # 230	994	75	28	7	Yes	Yes	Yes	Dry erase board, 25 (+) computers, one window non-operable, exhaust not working – blocked
Library	1396	73	34	16	Yes	Yes	Yes	3 broken windows – 1 duct taped, holes around wall clock, CT (20)
Mrs. McNulty's Office					Yes	No	No	Hole in wall for pipe penetration under sink
Library Annex Room				0	No	No	Yes	Exhaust off, passive vents, perfume odor

Room # 221 (Computer Room)	941		28	0	Yes	Yes	Yes	Exhaust off and blocked with trash can, univent motor off, 2 mimeograph machines, 21 computers, transparency machine, CT (5), water-stained curtains
Room # 209	950	75	30	40	Yes	Yes	Yes	Large plants on wooden window sill – potting soil, broken window, rubber cement, isopropyl alcohol, spaces around tile sink, unlabeled spray product
Room # 219	990	76	29	3	Yes	No	No	9 plants, dry erase board, water-damaged plaster, stained wooden window sills
Room # 218	798	73	26	8	Yes	Yes	Yes	Room divided in half – 9’ partition, duct tape caulking, exhaust blocked by bookcase, musty odor – carpet, 2 plants
Room # 211	1445	72	28	29	Yes	Yes	Yes	Exhaust off/blocked by student, univent blocked w/ books, boxes, desks, cleaning products under sink
History Office (S3)				0	No	Yes	No	Supply via passive door vent, old magazine/book storage, musty odor
Room # 205	958	74	28	14	Yes	Yes	Yes	Dust in heat vents Door open
Room # 204	1201	77	26	16	Yes	Yes	Yes	Supply off
2 nd Floor Hallway								Missing panel – water fountain – odors – wall, missing ceiling tiles
Room # 203	970	72	28	0	Yes	Yes	Yes	5 plants, door open Occupants gone 5 min.
Room # 208	923	73	26	1	Yes	Yes	Yes	Occupants (25) gone 5 min., excessive chalk dust, univent blocked by bookcase
Room # 207	1710	75	32	22	Yes	Yes	Yes	Exhaust off, chalk dust, peeling wallpaper
Room # 202	799	73	25	1	Yes	Yes	Yes	Exhaust off, broken window blocked with rag, 2 feather dusters mounted on wall,

								window open
Room # 206	1059	74	29	18	Yes	Yes	Yes	Exhaust off, window open, 1 plant, chalk dust
Room # 201	1286	76	30	20	Yes	Yes	Yes	Exhaust off, door open, broken window blocked with rag, 10 plants – trays of standing water, water-damaged cardboard organizer
Room # 101	1218	73	28	29	Yes	Yes	Yes	Exhaust off, univent partially blocked by cabinet, ceiling tiles painted over, door open
Room # 106	1480	75	31	20	Yes	Yes	Yes	Supply and exhaust off, door open broken/blocked window, CT
Room # 102	1321	74	27	20	Yes	Yes	Yes	Supply and exhaust off, 5 plants, cobwebs on window sill, chalk dust
Room # 107	1237	74	29	19	Yes	Yes	Yes	Supply and exhaust off, 1 plant, broken window, CT (6), cleaning products
Room # 103	1384	75	29	20	Yes	Yes	Yes	Supply off 4 plants on cloth
Room # 108	1418	73	33	0	Yes	Yes	Yes	Supply and exhaust off, chalk dust, 3 plants – window planter, door open, occupants gone 5 min.
Room # 104	1017	72	30	0	Yes	Yes	Yes	Supply off, exhaust blocked by trash cans, 8 plants, door/window open
Room # 105	1091	76	30	19	Yes	Yes	Yes	Supply off Temperature complaints (too hot)
1 st Floor Exit								Spaces around exit door

Main Office				0	No	Yes	Yes	Passive door vent supply/blocked, exhaust off and missing grill, transparency machine, photocopier, door open, duplicating fluid (open), 2 mimeographs
Room # 101	2000+	76	33	29	Yes	Yes	Yes	Supply off, window open, CT (30), hole in wall – pipe penetration, body odors
Room # 114	1750	76	29	28	Yes	Yes	Yes	Supply off
Room # 110	1408	78	28	20	Yes	Yes	Yes	Supply and exhaust off, CT (30), 7 plants, window planter, window open
Room # 113	1335	78	25	18	Yes	Yes	Yes	Supply off, plant in standing water, CT
Store Room								CT (10+) and missing some
Room # 109	2000+	75	31	21	Yes	Yes	Yes	Supply and exhaust off CT (41)
Room # 112	1079	77	27	27	Yes	Yes	Yes	Excessive chalk dust, birds nests, extreme temperature complaints, CT (27), loose windows, moldy caulking, supply/exhaust off
Guidance Office	1322	74	30	1	No	No	No	
1 st Floor Hallway (outside cafeteria)								1 missing ceiling tile CT (33)
Cafeteria	1330	70	36	30+	Yes	Yes	Yes	Damaged Fiberglass – piping, spaces exterior door, CT (30), exhaust behind hallway door, supply/exhaust off
Gym	1000	73	44	60+	No	Yes	Yes	Holes around exterior door, missing brickwork – water fountain
Instructors Office								CT/missing ceiling tiles, damaged insulation, drainage pipe

Gym Office								Mold and mildew on wall
Room # 189	620	68	30	1	Yes	Yes	No	Supply off Exposed Fiberglass
Woodshop	690	71	30	15	Yes	Yes	No	Supply off
Planning Room	682	72	27	0	Yes	Yes	Yes	Supply and exhaust off CT (30+)
Teachers Lunch Room	795	74	30	5	No	No	Yes	Exhaust weak, soda machine CT (20+), door open
Auditorium	711	71	31	0	No	Yes	Yes	Ventilation off, musty odors, cloth seats, below grade

* ppm = parts per million parts of air
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%